

Type I Progress Report

Nov. 16, 1972 - Jan. 15, 1973

Utilizing ERTS-A Imagery for Tectonic Analysis Through Study of Big Horn Mountains
Region. MMC #256
ERTS Contract #NAS5-21852

E7.3 1 0.0 3.6
CR - 129996

Principal Investigator - Richard A. Hoppin UN 633

We now have available 61 MSS scenes and 7 RBV scenes. At least one frame for each ordered scene has been received from the backorder data request submitted on 30 October, 1972. It is assumed that the missing frames are to be sent eventually or that the frames are not of satisfactory quality. Positive prints ordered on 6 November, 1972 were also delivered, but not the color composites.

We now have a scene in which the north central Black Hills is clear of clouds. We are now able to view almost the whole of the test area without cloud cover. The remaining image descriptor forms are enclosed; these cover the entire area but do not include some scenes on the periphery that are included in other scenes.

The roll of 9 x 9 RC - 10 aerochrome infrared from the August 11 U-2 supporting flight was received on December 11. The flights at 30,000 feet with I²S and RC8 cameras could not be flown by the Colorado State aircraft because of the early snows. The flights are rescheduled for early summer.

At this point we have no real problems and the investigation is proceeding well.

During this reporting period we have concentrated our efforts on the superb scene of the Bighorn Region (MSS #1085-17294). We are able to get excellent stereo viewing both with the original transparencies and with prints using sidelap scenes #1084-17235 to the east and #1061-17350 to the west. (The latter scene, along with others in this western portion of Wyoming and adjacent Montana have the anomalous white tone in the higher altitudes. It would be very helpful if these scenes could be reprocessed to remove the white because they are free of clouds).

Throughout our use of the 70 mm transparencies we have had excellent results using the Richards light table with binocular microscope and stereo prism attachment. We have also found paper prints to be very useful. To speed up the inspection process we have been making our own prints. Positive prints prepared from our own negatives are equal to those of the same scene processed by NASA. We have the added advantage that we can experiment quickly ourselves with exposure times and papers.

In making positive prints, a bit of the original resolution is lost. For these reasons we have been making use of negative prints with little loss of resolution until enlarged about 7 times. The 70 mm transparencies are projected in an Omega D2 enlarger using a 135 mm lens set at f11. Test strips are made to determine the correct exposure times. By varying the exposure times and development times we have been able to enhance features difficult to see on the transparencies, particularly in the basins. Our first series of negative prints were made with #3 Agfa paper. These

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proved adequate although it was difficult to get one exposure to provide the best density for both mountains and basins. In these cases we took two different exposure times which gave optimum results for each area. We have since gone to Agfa #2 paper and have had much better luck in getting one print to serve our purposes. When working with an area lacking these high contrasts between mountains and basins, using a higher paper number increases the contrasts; this is particularly true for scenes, or portions of scenes, of the basins.

For the purposes of structural and drainage analyses MSS bands 5 and 7 are best. Band 7 is particularly good for these studies because vegetation contrasts are subdued and the topography is emphasized. Enlarged negative prints of band 7 provide an excellent base for plotting linears and making drainage overlays.

Coinvestigator Drake has made the following observations regarding glacial features on 1085-17294:

- MSS-4. Cirques and moraines fuzzy. Not useful.
- MSS-5. Cirques hazy. Some lakes show up well. Major moraines and outwash appear to be differentiated more by vegetation than by topographic expression.
- MSS-6. See below as this is redundant with 7.
- MSS-7. Cirques and lakes show up well and in general topographic differences are sharply defined. Major moraines show good topographic expression.

We have experimented with 1085-17294 in the I²S Addac01 viewer. After much knob turning we found an interesting image showing much subtle, but more visible contrast. The combination was band 4 with blue filter, band 5 with green filter and band 7 with red filter. We are going to try to take pictures of this setting in the coming report period.

A corresponding RBV scene (1013-17291) shows nowhere near as good definition of drainage and structural detail and has much less contrast compared with the MSS. Only RBV-2 shows some promise. After 4 attempts we did get a 9 x 9 negative print of RBV-2 that enhanced the scene somewhat. The most striking part of the image is that the irrigated areas in the Bighorn Basin show up as well, if not slightly better than on any MSS band.

In the next period structural and geomorphologic analysis is to be extended to other scenes of the test area utilizing mainly band 7. Vegetation analysis will begin using band 5. In addition to the three investigators and research assistant, five additional graduate students are working on specific areas utilizing the imagery with followup field work in the summer. Several are also using the U-2 photography

No changes in standing order forms are expected. No new data requests have been required. We do not plan to use any precision process material as we have good map base on which to plot our data if necessary.

Summary of significant results (3K)

MSS scene 1085-17294 of the Big Horn region has been subjected to detailed structural analysis. Band 7 is particularly good for revealing structural and drainage patterns because of enhanced topographic detail and the subdued vegetational contrasts. Considerable stereo coverage through sidelap with adjoining scenes adds to the effectiveness of the study and has been used on both positive transparencies and enlarged prints. Negative prints of Band 7 positive transparencies have proven to be much more useful than positive prints because the higher resolution of the positive transparencies can be maintained. By varying parameters of exposure and development times, and paper type using an Omega D2 enlarger, optimum detail and contrast can be obtained from transparencies of quite different densities, particularly in the basins. The Bighorn Mountains are crisscrossed by a number of prominent topographic linears, most of which can be correlated with known fault and shear zones in the Precambrian crystalline core. Many of these do not appear to continue into the flanking sedimentary rocks and a few that do (Tensleep, Tongue River lineaments) are very difficult to trace farther out into the basins. The Tongue River lineament, long a source of speculation and uncertainty as to its existence, appears as a very prominent discontinuity in the imagery.